CARPENTER ELECTRIFICATION®

DATASHEET

SILICON CORE IRON A

Type analysis

Single figures are nominal except where noted

Iron	Balance	**Silicon**	1.00 %
Carbon	0.03 %	**Manganese**	0.15 %

Forms manufactured

Bar-Rounds	**Bar**
Billet	Many forms and conditions (request for cold drawn finish should be referred to Technical Department for acceptance)
Strip	

Description

Silicon Core Iron A is melted in electric arc furnaces to exacting chemical specifications, and carefully controlled in rolling and annealing processes to produce a fine-grain, uniform quality magnetic core iron.

A modified grade of Silicon Core Iron A, known as Silicon Core Iron A-FM, contains a free-machining additive to improve its machinability, especially for screw machine operations. It has been used primarily for solid cores that must be machined economically in volume.

Key Properties:

- Medium electrical resistivity
- High initial permeability
- Low hysteresis loss in AC and DC circuits with moderate formability

Markets:

- Aerospace
- Automotive
- Consumer
- Industrial

Applications:

- Solenoid switches
- Armatures
- Pole pieces
- Relays

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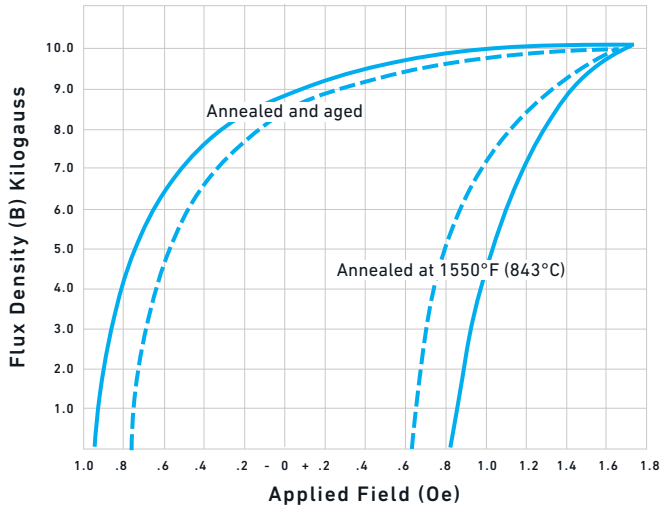
Physical properties

PROPERTY	At or From	English Units	Metric Units
SPECIFIC GRAVITY	—	7.75	7.75
DENSITY	—	0.2790 lb/in^3	7723 kg/m^3
MEAN COEFFICIENT OF THERMAL EXPANSION	77 to 750°F (25 to 399°C)	7.10 x 10^{-6} length/length/°F	12.78 x 10^{-6} length/length/°C
ELECTRICAL RESISTIVITY	70°F (21°C)	50.0 ohm-cir-mil/ft	25 microohm·cm
CURIE TEMPERATURE	—	1490°F	810°C

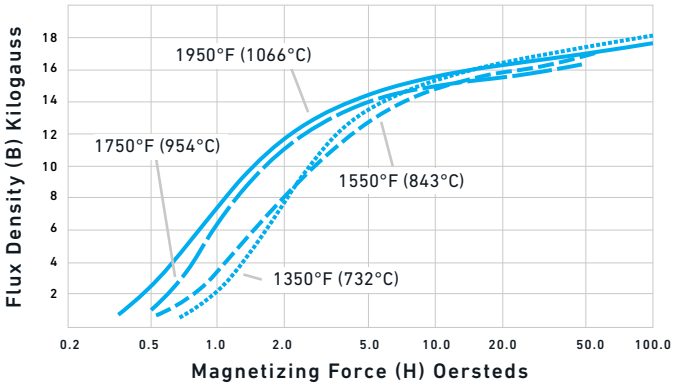
Direct current (DC) hysteresis

ANNEALED AT 1550°F (843°C) WET HYDROGEN/ 2 HR, AGED AT 302°F (150°C)/100 HR



Normal direct current (DC) magnetization curves

ANNEALED AT VARIOUS TEMPERATURES



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Magnetic properties

RESULTS DETERMINED FROM 3/8 IN (9.53 MM) DIAMETER BAR

SATURATION FLUX DENSITY (Bs)	21000 G	21 kG
COERCIVITY	0.900 Oe	
MAGNETIC PERMEABILITY	4500	
RESIDUAL INDUCTION	6500 G	6.5 kG
HYSTERESIS LOSS	2.91E-4 J/cm^3/cycle	0.291 kJ/m^3
TREATMENT FOR FINAL CLOSED PACK ANNEAL	1550°F	843°C

Typical mechanical properties

5/8 IN (15.87 MM) DIAMETER BAR

HEAT TREATMENT	0.2% YIELD STRENGTH		ULTIMATE TENSILE STRENGTH		ELONGATION IN 4D	HARDNESS
	ksi	MPa	ksi	MPa	%	ROCKWELL B
Mill anneal	35	241	55	379	30	60
Annealed[1]	20	138	45	310	35	50

[1] *Annealed for magnetic properties — 1550°F (843°C)*

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Heat treatment

Magnetic property requirements	Items as supplied from the mill are not in the most magnetic soft condition, nor are they supplied to magnetic property requirements. As supplied magnetic property requirements must be approved by the mill.
Heat treatment	Finish fabricated parts must be heat treated to achieve soft magnetic characteristics. Suggested heat treating atmosphere is a wet hydrogen atmosphere in the temperature range of 1550/1600°F (843/871°C), 2 to 4 hours at temperature and cooled 100/200°F (56/111°C) to 1000°F (538°C) and any rate thereafter.
Other heat treating atmospheres	Other heat treating atmospheres can be employed, such as nitrogen-hydrogen combinations, vacuum, exothermication, and inert atmosphere retort. Resulting magnetic characteristics will not be as good as the wet hydrogen atmosphere, which provides the best degree of decarburization.
Other heat treatment temperatures	Other heat treatment temperatures in the range of 1350/1950°F (732/1038°C) can be employed to achieve certain advantages such as brazing and fine grain size as required by end application. A sacrifice in certain magnetic characteristics will be realized. A dry atmosphere must be employed at 1750°F (954°C) and above.

Typical feeds and speeds

TURNING — SINGLE-POINT AND BOX TOOLS

DEPTH OF CUT, IN	HIGH-SPEED TOOLS			CARBIDE TOOLS			
	SPEED, FPM	FEED, IPR	TOOL MATERIAL	SPEED, FPM		FEED, IPR	TOOL MATERIAL
				BRAZED	THROW AWAY		
.150	80	.015	M-2	350	400	.020	C-6
.025	110	.007	M-3	400	490	.007	C-7

TURNING — CUT-OFF AND FORM TOOLS

SPEED, FPM	FEED, IPR							TOOL MATERIAL
	CUT-OFF TOOL WIDTH, IN			FORM TOOL WIDTH, IN				
	1/16	*1/8*	*1/4*	*1/2*	*1*	*1-1/2*	*2*	
70	.001	.0015	.002	.0015	.001	.001	.0007	M-2
250	.003	.0045	.006	.003	.0025	.0025	.0015	C-6

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DRILLING

SPEED, FPM	FEED, IPR — NOMINAL HOLE DIAMETER, IN								TOOL MATERIAL
	1/16	1/8	1/4	1/2	3/4	1	1-1/2	2	
70	.001	.002	.004	.007	.010	.012	.015	.018	M-42

TAPPING

SPEED, FPM	TOOL MATERIAL
15-20	M-1; M-7; M-10

DIE THREADING

SPEED, FPM				TOOL MATERIAL
7 OR LESS	8 TO 15	16 TO 24	25 AND UP, TPI	
8–20	10–25	15–30	20–35	M-1, M-2, M-7, M-10

MILLING — END PERIPHERAL

DEPTH OF CUT, IN	HIGH-SPEED TOOLS						CARBIDE TOOLS					
	SPEED, FPM	FEED, IN PER TOOTH — CUTTER DIAMETER, IN				TOOL MATERIAL	SPEED, FPM	FEED, IN PER TOOTH — CUTTER DIAMETER, IN				TOOL MATERIAL
		1/4	1/2	3/4	1-2			1/4	1/2	3/4	1-2	
.050	60	.002	.003	.005	.006	M-42	300	.0025	.004	.006	.008	C-6

Additional machinability notes

Figures used for all metal removal operations covered are average. On certain work, the nature of the part may require adjustment of speeds and feeds. Each job has to be developed for best production results with optimum tool life. Speeds or feeds should be increased or decreased in small steps.

Other information

Applicable specifications	ASTM A867, Type 1

For additional information, please contact your nearest sales office:
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